REMARKS

Claims 1 and 4 are presently pending in the application.

Claim 3 has been cancelled and the subject matter thereof has been incorporated in claim 1. Thus, all of the claims now specify that the electroconductive particulate substance in the electroconductive resin layer comprises a vitreous carbon powder having a specific surface area of less than 100 m^2/g. In addition, claim 1 has been amended to specify that the resin has at least one of water repellant and basic radicals, i.e., one or both, as is clear from the specification at page 7, lines 1-3. No new matter has been added by this Amendment, and entry is respectfully requested.

At the outset, the Examiner's attention is directed to the Information Disclosure Statement filed February 23, 2004, in which the prior art from an Office Action in the counter-part Chinese patent application has been submitted for the Examiner's consideration. Consideration of the additional prior art and initialing and return of a copy of the form PTO/SB/08A are respectfully requested.

The Examiner has rejected claims 1 and 3 (now claim 1) under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 5,607,785 of Tozawa et al. ("Tozawa") in view of U.S. published patent application US2002/0034672 of Saito et al. ("Saito"). In addition, the Examiner has rejected claim 4 under 35 U.S.C. § 103(a) as being unpatentable over Tozawa in view of Saito and further in view of Japanese publication JP 11-126620 ("JP '620"). These rejections are essentially the same as the Examiner's rejections in the Office Action dated June 4, 2003 (Paper No. 6), except that now that U.S. patent 6,451,469 of Nakamura et al. has been withdrawn as a reference in view of Applicants' submission of an English translation of the priority document for the present application, the Examiner has instead taken the position that the specific surface area of the carbon powder specified in the claims is an inherent property and/or characteristic of the conductive carbon powders of Saito, including the conductive powders of carbon black, natural graphite and acetylene black disclosed, for example, in Tables 1-8 of Saito (see paragraph in italics at the top of page 5 of the Office Action). These rejections are respectfully, but strenuously traversed for the reasons set forth in detail below.

The Examiner relies upon Tozawa to show the basic structure of a polymer-electrolyte fuel cell having separators 6A and 6C with current collector portions 7A and 7C to which a load

8 (mistakenly labeled as B in Fig. 1) is applied to withdraw electric power. Accordingly, the Examiner concludes that the separator material must be a conductive material (see middle of page 3 of the Office Action). The Examiner acknowledges that Tozawa does not expressly disclose (a) a separator comprising a metal substrate and the specific electroconductive resin layer comprising resin and electroconductive particulate substance and (b) the particulate substance comprising vitreous carbon, as presently claimed.

However, the Examiner relies upon Saito as disclosing a fuel cell separator having a conductive coating 2 of particular composition on a base material 1 (see Fig. 1). The Examiner notes that the conductive coating of Saito may comprise a conductive powder of carbon material typified by natural graphite, artificial graphite, carbon black, Ketjen black, expanded graphite or the like, with no particular restriction on the kind of conductive powder as long as the powder is conductive (paragraph 0021). The Examiner further notes that the base material for the fuel cell separator may be made of glassy carbon (paragraph 0035), which the Examiner contends is also called vitreous carbon (see paragraph bridging pages 5 and 6 of the Office Action).

The Examiner concludes that it would have been obvious to one skilled in the art to make the separator of Tozawa with the specific metal substrate and specific electroconductive resin layer of Saito, because Saito teaches that separators for solid polymer-type fuel cells are desired to have electrical conductivity and low electrical resistance, and Saito's specific separator and conductive coating improve the electrical conductance and low electrical resistance behavior of the separator (full paragraph at page 6 of Office Action). In addition, the Examiner concludes that it would have been obvious to make the separator of Tozawa having a particulate substance comprising vitreous carbon, because Saito discloses the conductive coating as comprising conductive powder without particular restriction on the kind of conductive power, as long as it is conductive.

In this regard, the Examiner contends that one skilled in the art would be motivated to use an electroconductive particulate substance such as glassy carbon to make the required conducting coating or film on the separator material, since Saito employs glassy carbon to make a conducting separator material. Moreover, the Examiner contends that Saito encompasses the use of glassy carbon as the electroconductive particulate substance because he teaches that any kind of conductive powder can be used in the film, as long as the powder is conductive, as well as the

possibility of obtaining a coated separator material with a carbon material, such that the separator as a whole can be obtained by combining two or more kinds of disclosed separator materials including glassy carbon (see paragraph bridging pages 6 and 7 of the Office Action).

Applicants strenuously object to the Examiner's reconstruction of the teachings of Saito based upon hindsight acquired from the teachings of the presently claimed invention.

First, contrary to the Examiner's contention, Saito does not encompass use of glassy carbon as the electroconductive particulate substance. The only teaching in Saito of the use of glassy carbon is use as a carbon separator material obtained by converting glassy carbon or graphite into a separator shape by machining (paragraph 0035, lines 5-7). There is no teaching or suggestion that this glassy carbon or graphite is in the form of powder particles, and the conversion by machining suggests that the glassy carbon or graphite is in the form of a solid block or plate.

Second, while it is true that Saito states in paragraph 0021 that there is no particular restriction on the kind of conductive powder, the only examples given for the conductive powder are natural graphite, artificial graphite, acetylene black, carbon black, Ketjen black and expanded graphite. There is no teaching or suggestion to use vitreous carbon as the conductive powder.

Third, as acknowledged by the Examiner, there is no teaching or suggestion in Saito, or any of the other cited references, of using a vitreous carbon powder having a specific surface area of less than 100 m^2/g. Further, as demonstrated below, there is no reason to suspect that Saito might inherently use electroconductive powders having a specific surface area of less than 100 m^2/g.

In establishing a prima facie case of obviousness, it is not sufficient that a teaching of a prior art reference simply be consistent with or have the possibility of including a material used in the claimed invention. There must be a specific teaching or suggestion <u>and</u> motivation in the prior art to use the claimed material. Further, in order to establish a case of anticipation or obviousness based upon inherency, it is also not sufficient that the prior art reference merely have the possibility of possessing the characteristics and/or properties of the material of the claimed invention. Instead, the material of the prior art must <u>necessarily</u> possess the properties and/or characteristics of the claimed material. In order to shift the burden of proof to Applicants,

the Examiner must point to some valid reason in the prior art to suspect that the prior art material does in fact possess the property and/or characteristic of the claimed material.

In the present case, the Examiner has failed to consider the actual problems and solutions with which the present inventors and Saito were concerned. Consideration of these problems and the respective solutions, as discussed below, reveals that the composition of the electroconductive resin layer of the present invention is quite different from that of Saito.

The particular composition of the electroconductive resin layer of the separators in the fuel cell of the present invention was developed to solve the problem of corrosion of the metal substrate of the separator and resultant damage to the membrane electrode assembly (MEA) due to metal ions leaching from the metal substrate of the separator into the MEA. As discussed at pages 3 and 4 of the present application, electroconductive separators utilizing metal substrates require strong corrosion resistance due to long-term exposure to high-humidity gases. Further, it is important to suppress contact resistance between the electroconductive separator and the MEA in order to heighten the electric cells' power-generating efficiency. A number of solutions to this problem have been proposed by the prior art (as discussed at pages 3 and 4 of the specification), but these solutions have been inadequate, because either the stable passive state layer provided on the substrate increases contact resistance, or there are problems with durability such that, when the cells are run long-term, the metal ions still leach out of the metal substrate and cause MEA damage.

In order to solve these problems, the present invention provides an electroconductive resin layer comprising a resin having water-repellant and/or basic radicals and an electroconductive particulate substance comprising carbon powder particles having a specific surface area of less than 100 m^2/g. These electroconductive powder particles preferably comprise vitreous carbon (see page 5 of the present specification). The reasons that these particular features of the presently claimed invention are successful in alleviating the problems of the prior art are discussed in more detail at pages 6-10 of the present specification.

In particular, since water is produced at the cathode by galvanic reaction, and water vapor is thought to condense in the area where the electroconductive separators and the gas-diffusion electrodes contact. Carbon dioxide gas and ionic impurities dissolve in the condensed water vapor, and corrosion of the metal substrate of the separator develops as a result. By providing an

electroconductive resin layer in which the resin has water-repellant and/or basic radicals, ionically conductive water is prevented from permeating the electroconductive resin layer and reaching the surface of the metal substrate. Moreover, the basic radicals heighten the surface pH of the separator and stabilize the passive state layer formed on the metal, so that corrosion of the passive state layer in acidic atmospheres and resulting leaching of metal ions is restrained (see paragraphs at the bottom of page 7 through the top of page 8 of the present specification).

Further, according to the preferred embodiment of present claim 4, leaching of metal ions from the metal substrate is restrained by including on the surface of the metal substrate a layer containing metals such as zinc, tin or aluminum, or oxides or hydroxides of chromium, molybdenum or tungsten (see third paragraph at page 8 of the specification).

Since metal ions created in the surface of the metal substrate leach to the exterior of electroconductive separator due to dispersing on the interface between the resin and the electroconductive particles, the specific surface area of the electroconductive particulate substance must be kept small. Among the possible carbon powders which are effective as the electroconductive particulate substance, vitreous carbon powder is preferred because the metal ions are thought to disperse through the spacing of the layers in layered graphite and leach to the exterior. However, a mixture of vitreous carbon powder and layered graphite is preferred in terms of balancing electroconductivity and control of metallic ion elution (see bottom of page 8 and middle of page 9 of the present specification).

These problems and solutions are not suggested or discussed in the Saito patent. To the contrary, Saito is directed to producing a fuel cell separator having superior hydrophilicity and water-holding capacity, while at the same time having low electrical resistance. In order to achieve these objectives, the conductive powder is subjected to a hydrophilization treatment by control of firing conditions or by using a chemical, a gas or the like (see paragraphs 0022 and 0027-0029 of Saito). Separators of Saito having satisfactory hydrophilicity at the surface hold 0.3 or more grams water per gram of unit weight of the film (paragraph 0049). As shown in Fig. 1, the conductive coating 2 is filled with holes 3 and unevenness 4 resulting from the removal of perishable additives and the secondary particles of the conductive powder.

Thus, it is evident that the surface area of the electroconductive particles of Saito must be designed as large as possible in order to provide the porosity necessary to hold water. On the

other hand, the surface area of the electroconductive particles of the present invention should preferably be as small as possible in order to decrease the interface between the resin and the electroconductive particles to inhibit dispersion of metal ions leached from the metal substrate to the exterior of the electroconductive separator (see paragraph bridging pages 8 and 9 of the present specification).

There is no hint in Saito of any awareness of this problem or any suggestion of keeping the surface area of the electroconductive particles small, such as having a specific surface area of less than 100 m^2/g, as presently claimed. Instead, Saito teaches away from a small surface area and requires a large, porous surface area in order to retain water.

Furthermore, there is no recognition in Saito of the difference between vitreous carbon and graphite. As contended by the Examiner, Saito places no particular restriction as to the kind of conductive powder which can be used. Therefore, Saito would not have had any preference for vitreous carbon over graphite for the particulate material, and does not even mention vitreous carbon as a possibility among the conductive powders exemplified in paragraph 0021.

In fact, one skilled in the art who might know that vitreous carbon does not have a layered structure as graphite does, would be led away from using vitreous carbon for the separators of Saito, because Saito is not concerned with the effect of preventing ion dispersion, but instead with the desire to hold water in the electroconductive coating. Therefore, the person skilled in the art following the teachings of Saito would more likely select the layered structure of graphite.

In sum, even if one skilled in the art were motivated to employ the separators of Saito in the fuel cell of Tozawa, for the reasons suggested by the Examiner at the middle of page 6 of the Office Action, the person skilled in the art would not have been motivated to use vitreous carbon powder having a specific surface area of less than 100 m^2/g in the electroconductive coating layer of Saito, for the reasons discussed above. Moreover, one skilled in the art would not have been motivated to use a water-repellant and/or basic radical-containing resin in the electroconductive resin layer, in view of Saitos' desire to increase water-holding capacity of the separator. In fact, Saito teaches away from using both of these features of the presently claimed invention, since the hydrophilization treatment to which Saito subjects the conductive powder suggests that Saito is trying to increase the surface area of the powder and layer to hold water.

Therefore, a specific surface area of less than 100 m^2/g is not at all necessary or inherent in Saito, but is in fact antithetical to the teachings of Saito.

Accordingly, the rejections over the combination of Tozawa and Saito based on obviousness or inherency are improper, and reconsideration and withdrawal of the rejections are respectfully requested. Since the rejection of claim 4 is based upon the same combination of Tozawa and Saito, this rejection is also improper for the same reasons and should be withdrawn.

In view of the above amendments and remarks, it is submitted that all of the claims in the application are in full condition of allowance. Reconsideration and an early Notice of Allowance are respectfully solicited.

Respectfully submitted,

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March 29, 2004
(Date)

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